

The removal of UXO and DU penetrators or fragments and contaminated soil would be a significant effort. Mason and Hanger (1992) estimated that the cleanup of the entire DU Impact Area could require a minimum of 1,000 weeks (approximately 19 years). Because of the occurrence of UXO in the DU Impact Area, excavation would be done remotely to ensure worker safety, thus increasing the time and cost to complete the project (U.S. Army 1999). Also, if UXO is buried throughout the DU Impact Area, then approximately 1,300 acres (5.3 km²) of the 2,080 acres (8.4 km²) of land would have to be excavated, resulting in the destruction of habitat for many species of plants and animals, significant soil erosion, increased runoff, and disturbance of stream sediment. Estimated cleanup costs for the DU Impact Area ranged from \$715 million to \$3.3 billion (Mason and Hanger 1992). Escalating these costs to current dollars, based on changes in the Bureau of Labor Statistics consumer price index, results in 2001 costs ranging from \$900 million to \$4.1 billion.

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5.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

The environmental impacts from implementing Alternative 1, license termination under restricted conditions (Proposed Action) (Section 5.1); Alternative 2, license termination for unrestricted use; and Alternative 3, the No Action Alternative are described in this section. Table 5-1 compares the impacts from implementing these three alternatives.

5.1 ENVIRONMENTAL IMPACTS OF ALTERNATIVE 1: LICENSE TERMINATION UNDER RESTRICTED CONDITIONS (PROPOSED ACTION)

This section discusses the short- and long-term impacts from implementing the Proposed Action. Sections 5.1.1 to 5.1.13 address land use; transportation; geology and soils; water; ecological; air quality; noise; historic and cultural; visual/scenic; socioeconomic; environmental justice; public and occupational health; and waste management impacts. Section 5.1.14 discusses cumulative effects of the Proposed Action while Section 5.1.15 addresses mitigative measures.

5.1.1 Land Use

Implementation of the Proposed Action would not result in any changes to current land use. Access to the DU Impact Area would continue to be controlled in accordance with the MOA negotiated between the Army, the USAF and the FWS (U.S. Army 2000a). The Army would continue to consult with both the FWS and USAF to ensure that ongoing Army activities (e.g., remediation and UXO demonstration projects) are compatible with refuge and bombing range activities. The FWS and USAF would continue to implement related institutional controls in accordance with the MOA (Appendix A), and as described in Section 1.5.1. The Army will retain authority, responsibility, and liability for remediation of all UXO, DU, and other contamination resulting from past Army activities or present activities on the firing range as of the date of the MOA.

5.1.2 Transportation

There would no impacts to transportation-related impacts (i.e., contaminant releases or impacts on transportation routes and traffic patterns) under the Proposed Action.

5.1.3 Geology and Soils

No additional short- or long-term impacts to geology would result from the Proposed Action. Soil contamination levels and depth in the DU Impact Area would essentially remain the same in the short-term, with possible migration of uranium with depth in the soil over the long-term. Monitoring data collected over an 11-year time frame indicate soils concentrations are at the average background soil concentration of uranium at JPG (see Section 3.1.2.3).

**Table 5-1. Comparison of Environmental Impacts
Jefferson Proving Ground, Madison, Indiana**

| Environmental Impact | Alternative 1: License Termination Under Restricted Conditions (Proposed Action) | Alternative 2: License Termination for Unrestricted Use of DU Impact Area | Alternative 3: No Action |
|---------------------------------|--|---|--|
| Land Use | No impacts. Land use at the DU Impact Area will remain restricted in accordance with the MOA. | No impacts. Because the DU Impact Area is surrounded by areas containing UXO, it is unlikely that the land would be available for other uses. Access to the area north of the firing line would still be restricted. | Impacts identical to the Proposed Action. |
| Transportation | No impacts | Short-term impacts including fugitive dust and noise. | No impacts |
| Geology and Soil | No short-term impacts. Possible long-term impacts associated with uranium migration with soil depth. | Short-term impacts associated with soil disturbance and removal. Landform would be transformed and surface drainage patterns altered. | Impacts identical to the Proposed Action. |
| Water Resources | No short-term impacts to either surface water or groundwater. Over the long term, there could be localized increases of uranium in surface water and groundwater from uranium migration. | Short-term impacts on surface water quality. Potential discharges to surface water via runoff during earth-moving activities. Positive long-term impact on groundwater quality from removing the source material. | Impacts identical to the Proposed Action. |
| Ecological Resources | No short-term impacts to biotic resources. Over the long term, uranium could accumulate in biotic resources. | Destruction of approximately 150 to 1,300 acres (0.6 to 2.8 km ²); loss of riparian habitat and biotic resources. | Impacts identical to the Proposed Action. |
| Air Quality | Possible short-term, local impacts with resuspension of DU particulates and oxides (low probability event). | Short-term impacts on air quality from the generation of fugitive dust emissions during earth-moving activities and from vehicular exhaust. | Impacts identical to the Proposed Action. |
| Noise | No impacts. | Short-term localized noise impacts from heavy equipment operation during the implementation phase. Noise impacts would be limited to the implementation phase when earth-moving activities occurred. | No impacts |
| Historic and Cultural Resources | No impacts. DU Impact Area previously was disturbed by ammunition testing. | No impacts. Potential cultural resources in DU Impact Area previously disturbed by ammunition testing. | No impacts. DU Impact Area previously was disturbed by ammunition testing. |
| Visual/Scenic Resources | No impacts | Visual/scenic resources impacted in the short term with destruction of local habitat. | No impacts |
| Socioeconomics | No impacts. | Potential short-term impacts would occur during remediation and are associated with the influx of the workforce supporting the site cleanup. Housing demand would rise to accommodate the increase in local employment. | No impacts |
| Environmental Justice | No impacts. | No impacts. | No impacts |

**Table 5-1. Comparison of Environmental Impacts
Jefferson Proving Ground, Madison, Indiana (Continued)**

| Environmental Impact | Alternative 1: License Termination Under Restricted Conditions (Proposed Action) | Alternative 2: License Termination for Unrestricted Use of DU Impact Area | Alternative 3: No Action |
|----------------------------------|---|--|---|
| Public and Occupational Exposure | <p>If institutional controls are maintained, then both UXO and radiological hazards would be minimized. UXO hazards and risks predominate and could result in injury or fatality. Radiological impact to site workers and public would be a few millirem per year (mrem/year) and below the NRC standard of 25 mrem/year.</p> <p>With a loss of institutional controls, the potential for health effects would increase. The site hazards would be dominated by the presence of UXO. The radiological impact to intruders would be less than 100 mrem/yr.</p> | <p>Potential for short-term impacts remediation. UXO related incidents and industrial accidents could occur.</p> <p>UXO hazard would remain in the areas surrounding the DU Impact Area.</p> | Impacts identical to the Proposed Action. |
| Waste Management | No impacts. | Significant quantities of soil contaminated with DU would require management and disposal in accordance with federal, state, and local laws and regulations. Ordnance and explosive was also would have to be managed and dispositioned. | No impacts. |

DU = Depleted uranium
MOA = Memorandum of Agreement

mrem/yr = Millirem per year
NRC = Nuclear Regulatory Commission

UXO = Unexploded ordnance

5.1.4 Water Resources

Under the Proposed Action, residual DU could be transported to surface water. However, because the DU was fired at soft, rather than hard, targets, most DU penetrators could be found intact, minimizing the area of contamination (Mason and Hanger 1992). As the projectiles age, uranium oxides will form, producing smaller flakes of DU material that could be carried off by surface water.

Surface water monitoring conducted along Big Creek upstream and downstream of the DU Impact Area from 1984 to 2000 detected variations in the concentration of uranium in surface water samples, but no long-term trends are evident. The isotopic ratios in the environmental monitoring data support the finding that most of the variation in uranium concentrations observed in surface water samples has been natural in origin (see Section 3.2). Naturally occurring uranium that has eroded from geologic deposits could be transported by surface water flowing across the DU Impact Area and draining into Big Creek.

Historic variations in uranium concentrations in groundwater have been attributed primarily to errors in sample handling (Ebinger and Hansen 1996). The data indicate no groundwater contamination attributable to the DU Impact Area. The ratio of U-234 to U-238 in groundwater samples has been near 1, indicating the presence of naturally occurring uranium (U.S. Army 2002b).

5.1.5 Ecologic Resources

The Proposed Action would not result in direct impacts because no earthmoving activities would occur; however, residual DU would remain in the DU Impact Area. DU could leach into soil and groundwater, be taken up by plants, and, ultimately, consumed by animals. Results of the biotic sampling discussed in Section 3.1.2.2 do not indicate high uranium concentrations in tissue samples. However, the results of the vegetation sampling discussed in Sections 3.1.2.1 and 3.1.2.2 indicate that those samples taken from near penetrator locations have uranium concentrations up to 3,447 pCi/g (Table 3-4 in Section 3). At these locations, minor impacts would be indicated to animals consuming vegetation.

Little to no impacts to wildlife are anticipated under the Proposed Action. Biological sampling does not indicate the presence of uranium, except in one lichen sample (see Section 3).

5.1.6 Air Quality

No air quality impacts would result from implementing the Proposed Action. Activities that could degrade air quality would be limited to occasional vehicle movement near the DU Impact Area for fence and sign checking and maintenance. Short-term, minor impacts to the air quality and visibility would result as a result of FWS prescribed burns; however, these impacts are independent of the Proposed Action. Related modeling assumptions for the range fire assessment are detailed in Williams et al (1998).

Past use of DU munitions has resulted in DU particulates and oxides possibly remaining in the soil in areas near the penetrator impact areas. These particulates and oxides can be resuspended into the air during wind storms. Air sampling was conducted at Yuma Proving Ground to determine the significance and magnitude of the soil to human exposure pathway. Particles greater than 20 microns in diameter would not remain airborne long enough to reach air samplers in the area. Furthermore the soil sampling indicated that 13 percent of the particles were under 125 microns – particles greater than 100 microns are not likely to be resuspended by wind. Because of the high density of DU, resuspension of uranium would be less than those particles of soil containing small amounts of uranium as observed in naturally occurring uranium soils. The results of this study and earlier studies conducted during 1979 to 1982 concluded that DU operations have no measurable impact on air quality (Gutierrez-Palmenber, Inc 1996). These results confirm that DU particles and oxides would not impact air quality at JPG.

5.1.7 Noise

There would be no noise impacts from the Proposed Action. No earth moving or vehicular traffic activities that could generate noise in the DU Impact Area would occur under the Proposed Action.

5.1.8 Historic and Cultural Resources

There would be no direct impact to cultural resources from implementing the Proposed Action because no earthmoving activities are proposed. The land in the DU Impact Area has been disturbed previously to depths of 3 to 25 feet (0.9 to 7.6 m) BGS by ordnance testing activities over the course of JPG's operational history (Geo-Marine 1996). Termination of the NRC license will not result in further disturbance of the land in the DU Impact Area.

5.1.9 Visual/Scenic Resources Impacts

There would be no impacts on visual or scenic resources within the DU Impact Area under the Proposed Action because there would be no construction or cleanup activities associated with license termination under restricted release conditions. Short-term impacts to the visual landscape would continue as a result of FWS prescribed burns; however, these impacts are independent of the Proposed Action.

5.1.10 Socioeconomics

There would be no socioeconomic impacts associated with the Proposed Action. Army personnel will visit the site on a regular basis to verify that the FWS and USAF are complying with the terms of the Memorandum of Agreement. Currently the U.S. Army has three full-time personnel, and the FWS has six personnel at the installation.

South of the firing line, approximately 200 people currently live and/or work in the JPG cantonment area on a daily basis. There are 13 residences south of the firing line. Individuals are employed in light industry and a small number of individuals support farming.

5.1.11 Environmental Justice

To determine if there would be an environmental justice impact from the Army terminating its NRC license for the DU Impact Area, the procedures established by the Office of Nuclear Material Safety and Safeguards were implemented (NRC 1999). Demographic data were obtained for the immediate site area, surrounding communities, the State, and the surrounding counties and towns. JPG is located in a rural area; therefore, a 4-mile (6.4 km) radius was selected for analysis (NRC 1999). The distance from the DU Impact Area to the western and eastern boundaries of the installation is approximately 2 miles (3.2 km). The distance to the southern boundary of the installation (which includes the cantonment area where the land either has been or is being transferred for private use) is approximately 4 miles (6.4 km). The distance from the DU Impact Area to the northern boundary of the installation is approximately 11 miles (3.2 km).

The total population residing in a 4-mile radius (6.4 km) is estimated conservatively (i.e., tends to be overestimated) because these data are available at the census block group level. Table 2-1 in Section 2 summarizes population data at the city, county, and State levels. After determining the number of people who resided in the 4-mile (6.4 km) radius, the percentage of minority and economically stressed households (defined as the number of people below the U.S. poverty level of \$17,650 for a family of four) within that population was determined and compared to the total population of such groups at the State and county levels.

The minority population within the 4-mile (6.4 km) radius was determined to be 0.3 percent. The minority populations of Jefferson County and the State of Indiana are 3.8 and 12.5 percent, respectively. The percentage of minority population in the affected 4-mile (6.4 km) radius is greater than 10 percent below the county and State levels.

The potential for disproportionately high and adverse impacts to economically stressed households was then evaluated using county data published through 1997 because more recent data are not available and no data are available for low-income populations at the census block group level in this area. Following the guidance in NRC (1999), the percentage of the affected population that was economically stressed was determined. This value was compared to the percentage of economically stressed households at the State level. Because JPG spans three counties in Indiana (Jefferson, Jennings, and Ripley), the percentage of economically stressed populations residing in each was averaged to obtain a value of 10.4 percent of the population being stressed economically. Table 2-1 indicates that the percentage of economically stressed households in the affected area at JPG is only approximately one-half a percentage point higher than at the State level (9.9 percent, see Table 2-1).

Because the minority and low-income populations residing in the area are significantly less than 20 percent of the affected population, environmental justice was not evaluated further as discussed in NRC (1999). There would be no environmental justice impacts from the Proposed Action to terminate the license.

5.1.12 Public and Occupational Health

Under the Proposed Action, the Army would maintain control of and restrict access to the area north of the firing line. The use of institutional controls would ensure that individuals who access the area north of the firing line are aware of the potential hazards. The DU Impact Area contains both UXO and DU; the UXO presents the immediate and most serious hazard to potential intruders into the DU Impact Area.

This section identifies potential exposure scenarios and estimates the human health impact from implementation of these scenarios. The analysis evaluates the impacts over two periods: an implementation phase (i.e., the period over which actions to terminate the license are conducted) and a post-implementation phase (i.e., the period after the license has been terminated). Both normal, expected case scenarios and abnormal or accidental scenarios are identified and evaluated. Both radiological and non-radiological hazards are addressed. This analysis provides a basis for understanding the impacts of the Proposed Action and determining compliance with NRC license termination standards for the action.

5.1.12.1 Implementation Phase Impacts

The Proposed Action does not include an implementation phase. Access to the area north of the firing line would continue to be controlled in accordance with the MOA, as described in Section 7. Minimal human health impacts would occur during this period.

5.1.12.2 Post-Implementation Phase Impacts

Under the Proposed Action, institutional control of the site would be maintained and access to the DU Impact Area would be limited. This section identifies and analyzes scenarios that could result in impacts either to site workers or members of the public under expected conditions (i.e., institutional controls remain in place) and conditions not expected to occur (i.e., the failure of institutional controls). For each scenario, both radiological and non-radiological impacts are discussed. Impacts of scenarios involving

exposure to radioactive materials were analyzed using the Residual Radiation (RESRAD V 6.1) model (Yu et al. 1993).

5.1.12.2.1 Expected Conditions (Institutional Controls Function)

Institutional controls for JPG include maintenance of an fence that surrounds the border of the installation; access control to JPG through a main gate; placement of warning signs around the DU Impact Area; maintenance of barricades on interior roads accessing the DU Impact Area; and use of a physical barrier, a fence, to separate the area north of the firing line from the southern portion of the installation. The exterior fence would be inspected on a weekly basis. In accordance with the MOA, the USAF would perform these activities. Public access to areas north of the firing line would be strictly controlled. Hunters and visitors are permitted with the Big Oaks NWR. Access to Big Oaks NWR would be allowed for hunting seasons (6 to 15 days) but not within the DU Impact Area. Awareness training and permits would be required for these visitors and workers prior to accessing the refuge. No public access would be allowed into the DU Impact Area which is located within the NWR (Figure 1-1).

Under these circumstances, only site workers and visitors could enter the DU Impact Area, and exposure times would be limited. These conditions support selection of site workers and occasional visitors as members of the group most likely to experience the greatest impacts if the Proposed Action is implemented.

Site Worker Activities—The maintenance of institutional controls would require site personnel to occasionally access the DU Impact Area for inspection or maintenance. These activities are expected to be of short duration and not involve site remediation. A radiological exposure scenario for these activities was developed and analyzed in Appendix C of the Decommissioning Plan (U.S. Army 2002b). Under this scenario, a site worker is assumed to spend 4 weeks per year in the DU Impact Area. Exposure modes include direct external, dust inhalation, and inadvertent ingestion modes. The estimated peak annual dose for this site worker ranged from 2.3 to 6.4 mrem/yr, depending on the average uranium soil concentration and the value of the uranium soil-water partition coefficient (U.S. Army 2002b). This dose is a small fraction of the annual background dose to an individual, which ranges from 200 to 300 mrem/yr. Such a site worker also could be exposed to UXO and be injured or killed.

Because the DU originated at DOE facilities that processed recycled uranium, there is the potential for very low levels of plutonium to be associated with the DU. Based on information from the Department of Energy (DOE 2000) and plutonium measurements in samples of DU ammunition fired in Kosovo (British Broadcasting Corporation [BBC] 2001), the isotopes Pu-239/Pu-240 could be present in the DU at concentrations of approximately 1 part per billion (ppb). If Pu-239/240 is present at this level in the DU at JPG, the dose for this exposure scenario would increase by less than 0.05 percent, a negligible increase.

Site Visitor Activities—The planned institutional controls also would allow members of the public to have access to the Big Oaks NWR. The FWS has rules and regulations for assigning visitors to areas on the refuge. The DU Impact Area is closed from public access (Appendix A). Visitors to Big Oaks NWR can participate in guided tours, wildlife observation and photography, fishing in Old Timbers Lake, and turkey or deer hunting. Because all of these activities occur outside of the areas with DU contamination, no doses to the public from residual DU are anticipated. Hunters who consume game that has grazed within the DU Impact Area could receive some dose from residual DU contamination. Calculations of the dose to humans from consuming deer meat yield estimates of dose ranging from 1.5 to 3.6 mrem/yr for total concentrations of uranium ranging from 94 to 225 pCi/g.

The NRC standard for license termination with restrictions (10 CFR 20.1403[b]) is that the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average

member of the critical group will not exceed 25 mrem/yr. These occasional site users are considered the average members of the critical group, and the near-zero dose complies with the NRC standard.

Offsite Activities—Uranium also could be transported offsite in surface water flowing through the DU Impact Area. Total uranium concentrations measured in streams that flow through the DU Impact Area and feed into Big Creek range from 0.77 to 25.02 picoCurie per liter (pCi/L). The single large detection was observed in a sample taken from a stagnant pool of an otherwise dry reach of the stream. Therefore, the average of observed values (3.6 pCi/L) represents a reasonably conservative estimate of the uranium concentration that an offsite individual could encounter. It was assumed that such an individual spent time in the creek for recreation, consumed drinking water and fish from the creek, and consumed crops grown in soil irrigated with water from the creek. Doses for recreation, drinking water consumption, fish consumption, and residential agriculture are estimated as 3.3×10^{-8} , 0.98, 1.0, and 0.003 mrem/yr, respectively. The sum of these doses is a small fraction of the NRC standard (25 mrem/yr) for this scenario. Because surface water draining the JPG flows westward to the East Fork of the White River, the nearest population affected by releases to surface water would be the town of Bedford, Indiana. Population dose for this town due to erosion-mediated release of uranium is 0.04 per-rem/yr.

5.1.12.2.2 Conditions Not Expected to Occur (Failure of Institutional Controls)

Although institutional controls are intended to restrict public access to areas north of the firing line that contain UXO and DU, a failure of these controls could occur. The hazard from a short-term failure of institutional controls, resulting in an individual spending time in the DU Impact Area, would be dominated by the UXO hazard. Contact with UXO could lead to injury or death.

The radiological hazard from spending moderate periods in the DU Impact Area (4 weeks per year) would result in a small dose (2.3 to 6.4 mrem/yr) for the site worker discussed above. The impact of a scenario that involves longer occupancy times and greater contact with residual contamination was identified and analyzed in the risk assessment (U.S. Army 2002b). In this scenario, the critical group establishes a residence and garden in the DU Impact Area. Exposure modes for this scenario include:

- Direct external
- Ingestion of drinking water
- Inhalation of dust
- Ingestion of plants and animal products
- Inadvertent ingestion of soil.

A series of conservative resident farmer scenarios were developed and analyzed in Appendix C of the Decommissioning Plan (U.S. Army 2002b). These scenarios are conservative given that construction of a house and garden in areas containing UXO and water use from the local aquifer are assumed. However, groundwater is not potable without extensive treatment because of the presence of sodium sulfate, and total dissolved solids (MWH 2002). The doses for these conservative resident farmer scenarios range from 15.4 to 37.0 mrem/yr, depending on the average uranium soil concentration and the uranium soil-water partition coefficient value (U.S. Army 2002b). The dominant pathways for this dose are external exposure and consumption of crops. If the isotopes Pu-239/240 were present at the level of 1 ppb as discussed above, the dose for this exposure scenario would increase by less than 0.002 percent, a negligible increase. As in the case of effective institutional controls, the potentially affected offsite population is located at Bedford, Indiana and the estimated population dose was 0.04 per-rem/yr.

The NRC standard for license termination with restrictions applies additional standards in the event institutional controls fail. The additional standard allows the license to be terminated if there is reasonable assurance that the TEDE from residual radioactivity to the average member of the critical

group will not exceed 100 mrem/yr if institutional controls fail. The results of the conservative resident farmer scenarios provide reasonable assurance that the TEDE to the average member of the critical group would be less than 100 mrem/yr.

5.1.13 Waste Management

No waste would be generated, transported, or disposed of under the Proposed Action. Therefore, there would be no related impacts. UXO and DU currently located in the DU Impact Area would remain and be subject to the institutional controls defined in the MOA.

5.1.14 Cumulative Impacts

This section evaluates the cumulative environmental impacts of the Proposed Action coupled with the impacts of other Federal, non-Federal, and private actions. No reasonably foreseeable actions were identified as occurring simultaneously with the Proposed Action. No other Federal actions at the installation were identified. The FWS will continue to operate the Big Oaks NWR and the USAF will continue to operate the Jefferson Range in accordance with the MOA. The continued ownership of the land north of the firing line by the Army would prohibit the development of approximately 51,000 acres of land for other uses. However, because of the occurrence of UXO throughout this area, the land is unavailable for other uses.

Most of the acreage south of the firing line is considered to be prime mixed development property and has been sold to a private individual. The Southeast Indiana Planning Commission did not identify any planned or ongoing major development efforts outside of the installation boundaries (SAIC 2001d). Therefore, no cumulative impacts beyond those from the Proposed Action were identified.

5.1.15 Mitigative Measures

Mitigative measures that could reduce the adverse impacts or enhance beneficial impacts are incorporated into this Proposed Action. The Army would continue to implement measures consistent with its authority and responsibilities under the BRAC program. These include, but are not necessarily limited to, implementing environmental remediation activities, leasing and transferring property south of the firing line, and executing its responsibilities under the MOA (Appendix A). The FWS and USAF would implement institutional controls in accordance with the MOA to ensure the facility is secure and operated safely.

The Army has no plans to continue environmental monitoring after license termination. Based on the anticipated environmental impacts, this potential measure would not provide significant value to mitigating the effects of the Proposed Action.

5.2 ENVIRONMENTAL IMPACTS OF ALTERNATIVE 2: LICENSE TERMINATION FOR UNRESTRICTED USE

Under Alternative 2, the DU Impact Area would be remediated to permit license termination for unrestricted use. Soil contaminated with DU would be removed to allow free release of the area. In addition, UXO also would be cleared to access DU-contaminated soils. Sections 5.21 to 5.213 address land use; transportation; geology and soils; water; ecological; air quality; noise; historic and cultural; visual/scenic; socioeconomic; environmental justice; public and occupational health; and waste management impacts. Section 5.2.14 discusses cumulative effects of the Proposed Action while Section 5.2.15 address mitigative measures.

5.2.1 Land Use

Under Alternative 2, approximately 150 to 1,300 acres (0.6 to 2.8 km²) of land in the DU Impact Area would be disturbed to remove DU fragments and contaminated soil (Scientific Ecology Group [SEG] 1995). However, because the DU Impact Area is surrounded by areas containing UXO, development of the land for other purposes would be unlikely.

5.2.2 Transportation

Short-term adverse impacts are anticipated to result from the remediation of the DU Impact Area. These impacts include noise, fugitive dust, siltation, and some plant and wildlife loss as a result of truck and vehicular movements along the perimeter of and to a smaller degree the interior to of the DU Impact Area (after appropriate clearance activities).

5.2.3 Geology and Soils Impacts

Both short and long-term impacts would result from remediation of the DU Impact Area. Short-term impacts to soils include movement and removal of existing soil and vegetation, siltation, and erosion. IN addition, the landform would be transformed and surface drainage patterns altered as a result of the excavation and soil removal activities. With appropriate mitigative and restoration measures, e.g., erosion control measures, seeding, and other restoration activities, impacts would be mitigated.

5.2.4 Water Resources

Surface water impacts would result from increased runoff during excavation activities, resulting in potential downstream sedimentation and uncontrolled migration of chemical or radiological constituents. Standard erosion control practices would be used during implementation of this alternative to minimize soil loss, downgradient sedimentation, and degradation of surface water quality.

Soil removal would eliminate the source for potential groundwater contamination. To date, no groundwater contamination attributable to the DU Impact Area has been detected.

5.2.5 Ecological Resources

Implementation of this alternative would have a significant impact on biotic resources and wetlands. Approximately 150 to 1,300 acres (0.6 to 2.8 km²) would be disturbed, resulting in the loss of habitat and destruction of plants and animals. Although wetlands have not been surveyed in this area, based on the National Wetlands Inventory map (FWS 1994b), approximately one-half of the DU Impact Area contains wetlands (Figure 2-11 in Section 2). The impact of removing these wetlands would be the possible death of riparian biota and loss of habitat. No impacts to floodplains would occur under this alternative since the DU Impact Area is not located within the 100-year floodplain of the Ohio River.

5.2.6 Air Quality

Under Alternative 2, air quality impacts would result from fugitive dust emissions generated by excavating contaminated soil, operating equipment and vehicles, and transporting contaminated soil and UXO from the site.

5.2.7 Noise

Implementation of Alternative 2 would result in short-term, localized noise impacts during operation of heavy equipment used for soil excavation and from truck traffic. However, no offsite noise impacts would be expected because of the distance from the DU Impact Area to the installation boundary.

5.2.8 Historic and Cultural Resources

Implementation of Alternative 2 would result in the disturbance of approximately 150 to 1,300 acres (0.6 to 2.8 km²) of land; however, because this area has been disturbed previously by ordnance testing activities, no adverse impacts to significant historical and archaeological resources would be expected.

5.2.9 Visual/Scenic Resources

Alternative 2 would substantially alter the nature appearance and character of the DU Impact Area. Vegetation cover would be removed and the natural contours of the land regarded. These changes would have an adverse impact on the quality and unity of this area's visual resources. With appropriate restoration measures and time (1-3 years), the local ecology would be reestablished.

5.2.10 Socioeconomics

License termination to allow unrestricted use would result in positive short-term socioeconomic impacts. Mason and Hanger (1992) estimate that cleanup of the DU Impact Area (including UXO) could take up to nearly 19 years. Therefore, local procurement of goods, services, and jobs would be generated if this alternative were implemented. These activities could result in increased housing demand and tax revenues for the local communities while the action was being implemented. At the end of the implementation period, a negative socioeconomic impact could result from workers leaving the area reducing the demand for public services.

5.2.11 Environmental Justice

There would be no disproportionately high and adverse impact from implementing Alternative 2. As discussed in Section 5.2.1.2, no potentially affected populations were identified.

5.2.12 Public and Occupational Health

Remediation of the affected portion of the DU Impact Area to meet unrestricted use criteria would generate dust containing both natural and DU dust that could pose a radiological hazard to site workers and the public. To manage this hazard, the Army would use protective measures such as soil wetting and work suspension on windy days. These measures would reduce the generation of contaminated fugitive dust emissions. In addition, other personal protection measures, such as respirators, could be used to ensure that worker doses are as ALARA. The potential doses would be well below the occupational regulatory limits of 5 rem per year (5 rem/yr).

Individuals offsite also could be exposed to uranium-containing dust; however, given the distance to the installation boundary and the use of mitigative measures, the magnitude of the potential dose to an offsite individual would be reduced. Review of the resident farmer scenario evaluated in Appendix C of the DP (U.S. Army 2002b) indicates the potential dose to an offsite individual during the implementation phase. The resident farmer analyzed in U.S. Army (2002b) would be exposed to soil with an average uranium concentration of 90 pCi/g and receive a peak inhalation dose of less than 1 mrem/yr. This dose is well below the applicable public dose standards of 25 mrem/yr for operating nuclear facilities.

If the DU Impact Area were decontaminated to levels to allow unrestricted use, the dose to members of the public who could use the remediated DU Impact Area would be less than the applicable NRC dose standard of 25 mrem/yr for unrestricted release.

5.2.13 Waste Management Impacts

Radioactive waste and UXO excavated during the remediation process will be stored, transported, and disposed of in accordance with federal, state, and local regulations. Waste designated for disposal offsite would be screened to minimize the volume of waste. Approximately 167,000 to over 4 million cubic feet (4,730 - 113,000 m³) of the soil is assumed to be contaminated with DU. UXO items detected and recovered will be transported to a secure area for detonation, if feasible. Otherwise, the ordnance item would be blown in place.

5.2.14 Cumulative Impacts

Cumulative impacts associated with remediation of the DU Impact Area for unrestricted use are similar to those discussed in Section 5.2.14.

5.2.15 Mitigative Measures

Mitigative measures that could reduce the adverse impacts or enhance beneficial impacts are included in this alternative. The Army would continue to implement measures consistent with its authority and responsibilities under the BRAC program for the DU Impact Area during the remediation process. These include but are not necessarily limited to implementing other environmental remediation activities, leasing and transferring property south of the firing line, and executing its responsibilities under the MOA (Appendix A). The FWS and USAF would implement institutional controls in accordance with the MOA to ensure the facility is secure and operated safely.

Mitigative measures would be applied before, during, and after remediation of the DU Impact Area. These measures include, but are not necessarily limited to the following: soil erosion control, site regrading, seeding, and revegetation. Operational procedures used by workers during planning and cleanup activities would incorporate measures to mitigate potential adverse impacts to the environment and to protect the health and safety of onsite and offsite personnel. The Army would not continue environmental monitoring after license termination and remediation was deemed complete.

5.3 ENVIRONMENTAL IMPACTS OF ALTERNATIVE 3: NO ACTION

Under the No Action alternative, the NRC license would remain in effect. The environmental impacts would be similar to those for implementing the Proposed Action. Sections 5.3.1 to 5.3.13 address land use; transportation; geology and soils; water; ecological; air quality; noise; historic and cultural; visual/scenic; socioeconomics; environmental justice; public and occupational health; and waste management impacts. Section 5.3.14 discusses cumulative effects of the Proposed Action while Section 5.3.15 addresses mitigative measures.

5.3.1 Land Use

There would be no land use impacts from implementing Alternative 3. The DU Impact Area would continue to be restricted from public access. The land in the area north of the firing line would continue to be managed in accordance with the MOA.

5.3.2 Transportation

There would no impacts to transportation-related impacts (i.e., contaminant releases or impacts on transportation routes and traffic patterns) under the no action alternative.

5.3.3 Geology and Soils

Existing vegetation covers would be preserved and no modifications to topographic contours would be made under the No Action Alternative; therefore, no impacts to geology and soils are expected to occur.

5.3.4 Water Resources

Under the No Action Alternative, there would be impacts to water resources would be similar to those described under the Proposed Action.

5.3.5 Ecological Resources

The No Action Alternative is not expected to have any negative effects on the biological resources near or within the DU Impact Area. Impacts would be similar to those described under the Proposed Action.

5.3.6 Air Quality

Air quality impacts under the No Action Alternative would be similar to those described for the Proposed Action. There would be minimal impacts to air quality since no action would be taken that could degrade air quality. Impacts would be similar to those described under the Proposed Action.

5.3.7 Noise

There would be no noise impacts associated with the No Action Alternative.

5.3.8 Historic and Cultural Resources

There would be no impacts to cultural resources from implementing Alternative 3. The DU Impact Area has been disturbed previously by the former UXO testing operations in this area.

5.3.9 Visual/Scenic Impacts

Impacts to visual or scenic resources under the No Action Alternative are identical to those anticipated under the Proposed Action..

5.3.10 Socioeconomics

The socioeconomic impacts of Alternative 3 would be the same as the Proposed Action.

5.3.11 Environmental Justice

There would be no disproportionately high and adverse impacts to any segment of the population from implementing the No Action Alternative.

5.3.12 Public and Occupational Health Effects

The human health effects from implementing the No Action Alternative would be the same as described for the Proposed Action.

5.3.13 Waste Management

Under the No Action Alternative, waste would not be generated or managed; therefore, no short- or long-term impacts are anticipated.

5.3.14 Cumulative Impacts

No cumulative impacts are anticipated under the No Action Alternative. These results are similar to those anticipated under the Proposed Action.

5.3.15 Mitigative Measures

The Army would continue to implement measures currently in place as caretaker of the facility, including retention of the NRC SUB1435 license and implementing related monitoring and reporting requirements and executing its responsibilities under the MOA (Appendix A).

6.0 ALARA ANALYSIS

This section summarizes the ALARA analysis presented in the DP (U.S. Army 2002b). This analysis was conducted to determine if the residual DU contamination in the DU Impact Area is consistent with ALARA.

The ALARA analysis consisted of identifying and quantifying, to the extent practical, the benefits and costs associated with decontamination of the DU Impact Area to unrestricted release conditions. The benefits identified and analyzed in the DP included: averted population dose, avoided regulatory and institutional costs, increased land value, aesthetics, and reduced public opposition. The total discounted benefit accruing from decontamination of the DU Impact Area to terminate the license without restrictions is estimated to range from \$268,286 to \$353,429 (see Table 6-1). The benefits are primarily the result of avoided institutional costs and averted population dose.

Table 6-1. Benefits of License Termination for Unrestricted Use of the DU Impact Area Jefferson Proving Ground, Indiana

| Parameter | Benefit (\$) ^a |
|--|---------------------------|
| Averted Population Dose | 61,143 to 146,286 |
| Avoided Regulatory and Institutional Costs | 207,143 |
| Increased Land Value | -- ^b |
| Aesthetics | -- ^b |
| Reduced Public Opposition | -- ^b |
| Total | 268,286 to 353,429 |

^a Based on an annual discount rate of 7 percent calculated over 1,000 years.

^b Benefit is minimal to none relative to other benefits quantified.

The costs identified and quantified included: UXO and DU remediation costs, occupational and public radiological exposure, occupational non-radiological risk to on-site personnel during decontamination, radiological and non-radiological transportation risks, and environmental degradation. The uncertainty regarding the nature and extent of both UXO and DU contamination and the associated remediation costs does not impact the conclusions of this ALARA analysis.

The total costs of remediating the DU Impact Area to achieve unrestricted release range from \$45 million to \$1.6 billion. The dominant cost elements being involve UXO and DU detection, removal, and disposition. These costs are summarized in Table 6-2.

Table 6-2. Costs of License Termination for Unrestricted Use of the DU Impact Area Jefferson Proving Ground, Indiana

| Remediation Cost Element | Cost (\$) ^a |
|---|-----------------------------------|
| UXO and DU Remediation Cost | 45,000,000 – 1,609,000,000 |
| Occupational and Public Radiological Exposure | 2,000 |
| Occupational Non-Radiological Risk | 6,300 |
| Non-radiological Transportation Risk | 132,000 – 3,670,000 |
| Environmental Degradation | 0 ^b |
| Total ^c | 45,000,000 – 1,613,000,000 |

^a Based on an annual discount rate of 7 percent calculated over 1,000 years.

^b No environmental degradation costs are anticipated over the long-term.

^c Total cost rounded to nearest million dollars.

The ALARA analysis determined that the costs of remediating the DU Impact Area to meet the criteria for unrestricted use are greater than the benefits, i.e., the costs are about 167 to almost 4,500 times the benefits. The ALARA analysis demonstrates that terminating the JPG license with restrictions would be consistent with the ALARA requirement of 20.1403(a).

In addition to the ALARA analysis, a “net public or environmental harm” analysis was conducted. This analysis compares the benefits of dose reduction with costs. These costs include occupational fatalities, occupational doses, transportation fatalities, and environmental degradation. The benefits were estimated to range between \$268,286 and \$353,429. Table 6-3 summarizes the costs for the categories enumerated above.

Table 6-3. Summary of Costs for “Net Public or Environmental Harm” Analysis Jefferson Proving Ground, Indiana

| Cost Element | Estimated Cost (\$) |
|--|----------------------------|
| Occupational Fatalities (Non-Radiological) | 6,300 – 12,600 |
| Occupational and Public Radiological Exposures | 2,000 |
| Transportation Fatalities | 132,000 – 3,670,000 |
| Environmental Degradation | 0 |
| Total | 140,300 – 3,684,000 |

This analysis indicates that for most situations, the benefits are less than the net public or environmental harm cost elements. It is expected that remediation of the DU Impact Area would result in “net public or environmental harm.”

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